1020 Atrial Endocardial Mapping

Tuesday, March 18, 1997, 3:00 p.m.–5:00 p.m.
Anaheim Convention Center, Hall E
Presentation Hour: 3:00 p.m.–4:00 p.m.

1020-70 Mapping of Atrial Activation and Tachyarrhythmias Using a Non-Contact Right Atrial Catheter

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To investigate the feasibility of single cycle mapping of atrial activation, a 9F non-contact 64 electrode balloon multi-electrode array (MEA); (ESI, Minneapolis, Minn.) was introduced via the femoral vein in 5 normal mongrel dogs and placed in a single atrial location. Virtual electrograms (VEGM) were computed by boundary element inverse solution at > 3000 endocardial sites for isopotential mapping. Right atrial geometry was estimated using a computer generated 3D map created by rapidly (< 3 minutes) positioning a standard 6F roving throughout the right atrium. The roving catheter had a "locator signal" transmitted through its tip. The roving catheter was placed in multiple fixed atrial locations and conventional contact electrograms (CEGM) recordings were made. In addition to examining differences in activation times between VEGM and CEGM, a template matching algorithm was used to compare VEGM and CEGM morphology. Atrial flutter and fibrillation were induced by rapid pacing.

Results: At sites $\leq$ 3.5 cm from the MEA, the mean difference in activation times between VEGM and CEGM was 1.2 $\pm$ 2.0 ms in sinus rhythm. VEGM morphology in sinus rhythm was well cross-correlated with CEGM morphology (correlation coefficient = 0.83). The location of the His Bundle and of the tricuspid valve (A = V) was easily identified by VEGM's. Non-contact isopotential mapping at a single MEA catheter location identified reentrant activity during atrial flutter and distinct activation wavefronts during atrial fibrillation.

Conclusions: Non-contact electrogram recording can generate accurate single cycle real time maps over a large portion of the right atrium. This technique has the potential to rapidly characterize and localize atrial tachyarrhythmias including fibrillation.

1020-71 Electrophysiologic Imaging of the Right Atrium Using a Noncontact Multielectrode Cavitary Probe

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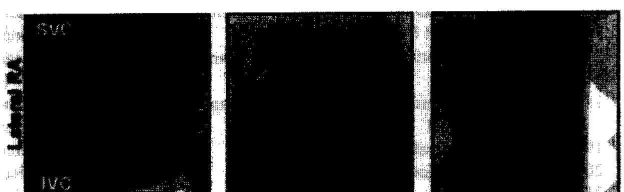
Our objective was to advance an electrophysiologic imaging technique to map, for the first time, right atrial (RA) endocardial potentials (electrograms) and activation sequences at multiple sites simultaneously. In 5 dogs (20–25 kg), a custom-made noncontact cylindrical probe (9 × 35 mm) with 64 electrodes on its surface was inserted into the RA through the inferior vena cava with the tip positioned in the appendage. Cavitary unipolar electrograms were recorded during normal as well as paced rhythms. The signals were used to reconstruct RA activation.



1: Sinus Rhythm 2: RV Pacing 3: LA Pacing

During sinus rhythm, RA activation initiated from the lateral wall (Fig. 1: black area in map of isochrones), which corresponded with the sinus node, and terminated at the atrioventricular (AV) node (white area). While pacing the right ventricle (Fig. 2), RA activation started from the AV node and propagated retrogradely to high RA. During left atrial pacing (Fig. 3), RA activation spread from posterior septum to lateral wall and proceeded to anterior free wall. There was no apparent interatrial conduction through the anterior-septal area.

Conclusions: This noncontact mapping approach reflects RA activation on a beat by beat basis throughout the endocardium. The method may allow for studying atrial arrhythmias, and may advance catheter ablation for managing these arrhythmias.

1020-72 Global Activation Patterns During High Density Electro-Anatomical Mapping of Atrial Flutter

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The geometry and properties of the reentrant circuit in human atrial flutter (AFl) remain incompletely characterized. We examined global activation patterns in 8 pts with counterclockwise AFl (cycle length 240 $\pm$ 36 ms) using a mapping system permitting rapid integration of activation times with precise 3 dimensional anatomic location (Biosense). Between 350 and 450 right atrial endocardial sites were sampled in each pt. *Results:* In each pt, activation around the tricuspid annulus (TA) spanned the AFl interval; activation of the remaining anterior atrium parallelled but never preceded TA activation. Estimated conduction velocities (ECV) along the TA were relatively uniform, ranging from 40–60 cm/s, with no discrete region of markedly slow conduction (septal 48 $\pm$ 6, anterior 56 $\pm$ 8, lateral 53 $\pm$ 9, inferior 53 $\pm$ 9 cm/s respectively). Following activation of the cavotricuspid isthmus, one wavefront continued counter clock-wise around the TA, while a second broader wavefront swept more rapidly posteriorly and superiorly across the septum and posterior wall (ECV > 0.7–1.2 m/s), activating the posterolateral right atrium in a caudal-cranial direction up to a line of block. Posterior activation was complete prior to cranial-caudal activation of the lateral atrium anterior to the line of block as part of the continuing initial wavefront around the TA. Double potentials were recorded along the line of block in the posterolateral and inferior right atrium. *Conclusion:* These data are consistent with the hypothesis that AFl is a macroreentrant circuit around the TA with relatively uniform ECV and no discrete area of markedly slow conduction.

1020-73 High Accuracy of Radio Frequency Catheter Ablations Guided by Non-Fluoroscopic Mapping System in the Swine Atrium

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We tested the accuracy of using a non-fluoroscopic mapping (NFM) system to guide Radio Frequency (RF) application In the right atrium (RA) of a swine. The NFM system uses ultra-low magnetic field to determine the location and orientation of the tip of a 7F ablation catheter. After sequentially acquiring a set of catheter tip locations (30–40 differnt sites) gated to a fiducial point in the cardiac cycle; the RA three dimensional (3D) geometry was reconstructed and presented to the operator. This 3D reconstruction together with the real time superposition of the ablation catheter's tip, was used to navigate the catheter to predefined sites. RF energy, 500 kHz for 60 sec in a temperature controlled mode (80ºC) was delivered at a predefined site and the catheter was withdrawn. This procedure was repeated three times each time the catheter was navigated to the same site. The distance between centers of the point ablations was 2.6 $\pm$ 0.6 mm (mean $\pm$ SEM; n = 6). Ablated area had an elliptic shape with 10.5 $\pm$ 1.1 mm long and 6.2 $\pm$ 1.2 wide mm dimensions. We have also delivered RF energy to create linear lesion in the RA (6–8 discrete lesions 4 mm apart). Sites where RF energy was applied were tagged on the NFM RA reconstruction. High correlation was found between lines on the maps and the linear ablation site on the heart. We conclude that the NFM can guide the application of RF energy in a highly accurate and reproducible manner, thus facilitating catheter based ablation.

1020-74 Accuracy of Electroanatomical Mapping of Atrial Fibrillation using a new Nonfluoroscopic mapping system

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A major limitation in the evaluation of the mechanisms underlying atrial fibrillation (AF) and in linear ablation procedures (modified maze), is the inability to associate relevant eletrophysiological information with the 3-D anatomy of the heart due the limitations of 2-D Fluoroscopy. We have evaluated the reproducibility and the accuracy of 3-D, local cycle length (CL) dispersion during AF in a chronic atrial paced goat model using a new non-fluoroscopic electroanatomic mapping (NFM) system. The NFM system uses magnetic fields to accurately determine the location and orientation of a locatable catheter and simultaneously records the electrogram from its tip. By sampling a plurality of sites where the tip is in stable contact with the endocardium and 60 seconds of atrial electrograms recorded at each site, the 3-D geometry of the chamber is reconstructed in real time, with the electrical information color coded and superimposed on the anatomy. Detailed histograms of the dispersion of CL at each site were acquired. The absolute location of each site was determined as the median location of the catheter during this time. Initially 66 recordings from 11 different sites in the right atrium were acquired. The location standard deviation was 1.1 $\pm$ 0.2 mm. The CL histogram at each site was determined from all recordings, then using goodness of fit methods we found that at 62 of 66 of the single recordings were statistically